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AUTOMATION OF GRANT APPLICATION WRITING WITH THE USE OF CHATGPT

Krzysztof RYBIŃSKI

Department of Business and International Relations, Vistula University, Warsaw, Poland;
k.rybinski@vistula.edu.pl, ORCID: 0000-0002-4604-7993
European Humanities University, Vilnius, Lithuania

Purpose: This paper examines the integration of generative AI, specifically ChatGPT, into grant application writing, evaluating its impact on efficiency, quality, and equity in research funding. The study aims to address systemic challenges in grant writing, such as high time investment, low success rates, and inherent biases against underrepresented groups.
Design/methodology/approach: The research analyzes the development and submission of four grant proposals to public and private funding bodies in the U.S. and EU. ChatGPT was employed to automate key components of the process, including generating proposal structures, drafting content, and formatting team qualifications. The outcomes were compared in terms of time efficiency, success rates, and the quality of applications.
Findings: The use of ChatGPT reduced the average grant preparation time from 30-50 days to 3-5 days while achieving a 50% success rate, significantly exceeding typical success rates of 10-20%. The findings highlight ChatGPT's potential to enhance the inclusivity of funding processes by mitigating biases and lowering entry barriers for junior faculty and underrepresented groups.
Research limitations/implications: The study is limited by the small sample size of four grant applications and the inherent variability of AI-generated outputs. Future research should explore scalability, reproducibility, and the ethical implications of AI use in academic and professional settings.
Practical implications: The adoption of AI in grant writing can streamline the application process, allowing researchers to focus on substantive project development. Funding bodies are encouraged to adapt evaluation standards to distinguish between human-authored and AI-generated content, ensuring fair assessments.
Social implications: By reducing biases and increasing accessibility, AI-driven grant writing can democratize research funding opportunities, fostering greater equity and diversity in academic and scientific communities.
Originality/value: This study provides the first empirical evaluation of ChatGPT's application in grant writing, offering insights into its transformative potential for academia, policy, and research funding practices. It is valuable to researchers, funding organizations, and policymakers seeking to leverage AI for more inclusive and efficient grant processes.
Keywords*:* generative AI, ChatGPT, grant writing automation, policy guidelines.
Category of the paper: research paper.

1. Introduction

This paper embarks on an exploration of a novel question within the realms of research funding and the broader missions of academic and civil society organizations. It examines the transformative impact of generative artificial intelligence (AI) and Large Language Models (LLMs) on the grant writing process. This exploration is multifaceted, addressing several critical dimensions.

In our study, we meticulously investigate the broad impacts of generative AI on the grant application workflow, structuring our analysis around five critical research questions. Initially, we examine the influence of generative AI on the time necessary to compile a grant application, focusing on its capacity to streamline the preparation phase, thereby reducing required time and labor. This productivity-centric question seeks to elucidate the efficiency improvements attributable to AI implementation. Subsequently, we evaluate how generative AI affects the quality of grant proposals, probing whether these technologies can enhance the content and presentation of applications, and thus address the quality aspect of our exploration. Furthermore, we scrutinize the evolving skill set demands for project teams applying for grants in the era of generative AI, particularly the necessity for skilled prompt engineers in producing superior proposals, which could significantly alter the skill requirements for successful grant writing. Moreover, we investigate the segmentation of the grant application process that could be entirely automated versus those segments needing human intervention or supervision, aiming to pinpoint areas where AI can autonomously function and where human expertise remains irreplaceable. Finally, we consider the wider repercussions of generative AI's proliferating use on both the structuring of the grant application process and the criteria for grant evaluation, a policy-oriented inquiry that assesses the need for updating existing protocols to maintain equity and efficacy in grant distribution. These inquiries are intended to offer an exhaustive perspective on the transformative impact of generative AI within the grant application sphere.

Generative AI, including tools like ChatGPT and other LLMs, is revolutionizing productivity across various sectors by automating complex business processes (Abdullahi, 2023; Alavi, Westerman, 2023; Candelon et al., 2023; Advarhyu et al., 2023; Marr, 2023). The economic impact of generative AI is significant, with projections suggesting an annual addition of $2.6 to $4.4 trillion to the global economy sectors (Chui et al., 2023). It is anticipated to increase labor productivity by 14-40% depending on the skill level of the workforce (Savchuk, 2023; Sommers, 2023).

Studies by Noy and Zhang (2023) confirm these trends, showing that ChatGPT can significantly enhance productivity in writing tasks. The average time taken is reduced by 40%, and output quality is improved by 18%, while also decreasing inequality among workers. This suggests that generative AI can elevate the standard of grant proposals, intensifying competition for funding and complicating the task of discerning quality proposals for reviewers.

Generative AI is increasingly used in firms' innovation processes and offers the potential for more radical innovations (Roberts, Candi, 2024). ChatGPT and other LLMs are utilized in a wide spectrum of applications, from programming assistance to creative content generation in many areas: human resources, programming, social media, office automation, search engines, and education, which documents the potential of LLMs to revolutionise business processes and services (Chiarello et al., 2024). The identified growth areas for ChatGPT applications include educational support and skill development, workflow enhancement, information retrieval, natural language interaction and assistance, and content creation and ideation (Cong-Lem et al., 2024). A growing body of literature examines the various forms of human-computer interaction in generative AI applications, focusing on their role in simplifying tasks for humans, adapting to user feedback, and defining the user's position within the AI loop (Raees et al., 2024).

The academic literature provides ample evidence of generative AI's capacity to disrupt traditional processes, enhance productivity and improve organizational performance (Rana et al., 2024). For instance, Abdullahi (2023) and Alavi and Westerman (2023) highlight the broad applicability of generative AI in automating tasks that were previously thought to require human creativity. This suggests a paradigm shift in how work is conceptualized and executed. The findings of Noy and Zhang (2023) are particularly relevant, demonstrating that the integration of ChatGPT in writing tasks not only enhances efficiency but also improves the quality of outputs. This is a critical factor in the context of grant writing where the articulation of ideas and clarity of presentation are paramount.

Research, such as a study from the University of Montana led by Dr. Erik Guzik Shimek (2023), demonstrates the creative capabilities of generative AI. AI-generated grant applications score highly in fluency and originality, challenging the traditional view of AI as a tool for routine tasks. Further studies reveal that AI-generated innovations are often indistinguishable from those created by humans (Zhou et al., 2024), sometimes even perceived as more innovative (Stock-Homburg, 2023), but the evidence on AI being able to surpass human creativity is still mixed (Grassini, Koivisto, 2024). ChatGPT's ability to produce high-quality academic abstracts that can deceive experienced scientists (Else, 2023), assist students in crafting well-referenced essays (Stokel-Walker, 2022), and its adoption in audit processes by major firms (Goto, 2023), highlights its potential to significantly enhance efficiency and creativity in professional and academic settings. However, this raises important ethical questions and concerns about bias in AI-generated content.

The adoption of ChatGPT and similar generative AI tools in academic writing is on the rise, as evidenced by a review identifying 104 papers generated with such technologies, with a significant number of authors failing to disclose their use of AI (Jain, Jain, 2023). The expansion of generative AI in academia is expected to accelerate, driven by new tools that support a wide range of academic activities (Garrido-Merchan, 2023; Glickman, Zhang, 2024). This proliferation brings to the forefront critical ethical considerations, the potential for bias, and the importance of maintaining academic integrity (Birhane et al., 2023; Chemaya, Martin,

2024), highlighting the need for transparent methodologies and rigorous validation to ensure the reliability of AI-assisted academic outputs (Ganjavi et al., 2023; Morris, 2023). There is also a continuous dialogue within the academic literature regarding the governance of artificial intelligence, the velocity of AI adoption, its influence on work, and the prerequisites for data governance in the artificial intelligence epoch. (Goos and Savona, 2024).

While LLMs have proven useful in advancing scientific research and streamlining the academic writing process, their application in grant writing holds even greater potential. The automation of generic components in funding applications and the desire for LLM-powered tools to draft initial proposals underscore this potential (Morris, 2023). The interest in leveraging ChatGPT for automated grant writing is evident in the organization of highly rated seminars and educational initiatives targeting graduate students (Kurlinkus, 2023; Steel, Fariborzi, 2023). Despite this growing interest, empirical studies examining the impact of generative AI on the grant writing process, including its efficiency, quality, and success rates, are lacking. I aim to address this gap by providing a comprehensive analysis of four grant applications generated by ChatGPT.

The structure of this paper is as follows: Section 2 offers background information on this research, including a concise overview of the four ChatGPT-assisted grant applications. Section 3 details the research methodology and the extent to which the grant writing process relied on ChatGPT-generated content. Section 4 presents the outcomes for all four grant applications. Section 5 discusses these results in the context of the research questions introduced in this section. Finally, Section 6 concludes the paper, outlining future research directions in this emerging field.

2. Background

In this pioneering study, I harnessed the capabilities of ChatGPT to craft four grant proposals, targeting funding opportunities from a diverse array of organizations: the Alfred P. Sloan Foundation and the National Endowment for Democracy (NED) in the United States (with two proposals directed here), alongside the Central Project Management Agency (CPMA), a Lithuanian entity tasked with the administration of projects financed by European Union and state funds. These proposals were designed to secure support for a variety of initiatives: the establishment of a specialized research and teaching lab at a university, a project aimed at bolstering civic society and human rights through innovative technology, and two proposals focused on groundbreaking sociological research to evaluate the impact of civic education.

I took the role of co-Principal Investigator in all four grant applications. My familiarity with the subjects of these proposals varied significantly, ranging from profound expertise, evidenced by numerous peer-reviewed publications, to a basic, non-expert level of understanding, and in one instance, minimal knowledge of the field. The funding sought in these applications spanned from $50,000 to $200,000, cumulatively approaching half a million dollars. The majority of the proposals represented the interests of a university, while one was submitted on behalf of a research center governed by NGO principles.

The composition of the project teams also varied, including both external experts, who contributed primarily through discussions and CV submissions, and internal staff from the university or center. All team members were briefed on the innovative approach of utilizing ChatGPT for the grant writing process and agreed to this methodology. Each team, in conjunction with their respective institution, fulfilled the formal criteria for grant eligibility.

As the sole author and submitter of these applications, I ventured into this process without prior experience in applying to the specified funding bodies. My background includes a mixed success rate in securing research and civil society funding, and a Google Scholar h-index of 14. The overarching aim was to generate high-caliber proposals that adhered to the grantors' guidelines and would ultimately be successful in securing funding. In anticipation of a favorable outcome, both the institutions and the expert teams were prepared to undertake the projects, equipped with the necessary skills and experience for effective and timely execution.

Neither the university nor the research center had previously engaged in these funding bodies' calls for grants, remaining unknown to the U.S. grantors. However, the university had benefited from CPMA's EU-financed technical assistance for institutional capacity building. The diverse nature of the applications—encompassing large and small institutions, internal and external team collaboration, funding from both private foundations and government agencies, and projects ranging from research-intensive endeavors to civic society initiatives with technological and research elements—provided a comprehensive test of ChatGPT's efficacy in generating grant proposals across various subjects, geographic locations, and funding requirements.

In a notable development, a one more project team was established at the university with the intention of submitting a grant application to the CPMA. This team also did not possess previous experience in applying for CPMA grants. Unlike in my case, this newly formed group did not utilize generative artificial intelligence to facilitate the application process. Despite fulfilling the formal prerequisites, the team was unsuccessful in submitting their application. This outcome suggests that the support provided by generative AI could be highly beneficial in the application process.

As outlined in Table 1, among four grant proposal two were accepted and two were rejected, with a success rate of 50%.

3. Methodology

This section delineates the methodology employed in the preparation of grant applications. Among the cases studied, three applications were crafted anew, while one was an iteration of a previous submission, adjusted in scope and geographical extent. A unified approach was adhered to across all instances, detailed as follows.

Setting up a generative AI assistant

For this study, a new instance of a generative AI assistant, specifically a ChatGPT-4 model, was configured with capabilities crucial for the task at hand. These included the ability to parse information from the Internet and both PDF and Word documents; generate text adhering to American English standards in three instances and British English in one, ensuring compliance with the linguistic preferences of the funding bodies; and craft text with a positive tone aimed at enhancing appeal to evaluators. Additionally, the assistant was programmed to accurately format references and to seek clarifications through follow-up queries if the initial prompts were ambiguous.

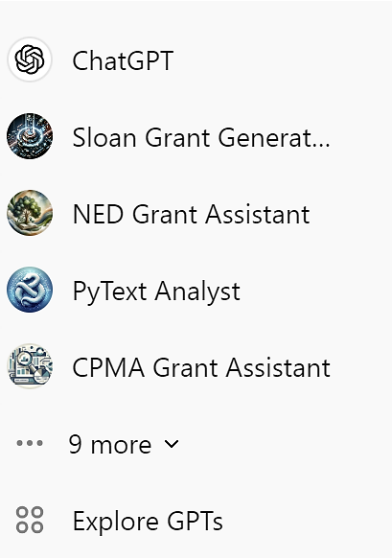

Figure 1. ChatGPT grant writing assistants (screenshot).

Data provision to the AI assistant

In each scenario, the AI assistant was furnished with two key documents: detailed grant application guidelines from the grantor's website, typically spanning 10-20 pages, and a concise project description. The latter varied, ranging from a brief 2-3-page overview crafted by the project team to a 23-page prior grant application produced by the ChatGPT assistant. Furthermore, CVs of project team members, varying in format and content, were provided. The assistant's task was to harmonize these CVs into a consistent format as per the grantor's stipulations, selecting information pertinent to the project's scope.

Prompting and text generation process

The initial phase involved instructing the ChatGPT assistant to outline the application structure to align with the grant guidelines. Subsequently, it was tasked with generating distinct sections of the application. Upon assembling a complete draft, the assistant evaluated the coherence and adherence to guidelines, proposing modifications to enhance the application's persuasiveness. These recommendations were then reintegrated into the generation process to refine the application. In certain instances, the assistant affirmed the initial draft's compliance, negating the need for alterations.

It is important to note that each of the four cases in our study was different and required slightly different prompts. The overarching objective was not to derive a universal set of prompts but to investigate whether generative AI could produce high-quality research proposals within a notably short time frame. Although we cannot provide the exact unified prompts used, each step in Table 1 corresponded to a separate, case-specific prompt that was modified between proposals as needed. Furthermore, certain sections of each proposal required multiple iterations of prompt revision to achieve the desired detail or clarity. This approach allowed us to tailor the text generation process to each unique proposal context while maintaining a consistent methodological framework.

Notably, the text generation process was autonomous, with no manual alterations made to the AI-generated content. While some sections, such as those detailing project risk management or promoting gender equality, were proficiently crafted on the first attempt due to the availability of standardized guidelines online, other sections necessitated iterative refinement. This was particularly true for the standardization of CVs, where multiple iterations were sometimes required.

In the concluding phase, all requisite formal documents were collected, and the complete application package was submitted to the funding entity.

Leveraging a pre-existing proposal

An integral component of this research was assessing the AI's capability to repurpose an existing grant application for a new submission, adhering to ethical guidelines. A 23-page PDF of the original application, alongside the grant guidelines, was uploaded to the AI assistant. The assistant was then provided with a succinct list of required modifications, which included narrowing the scope of grant activities, altering the geographical focus, and adjusting the anticipated outputs and outcomes to emphasize scholarly publications over policy impact. As elucidated in the Results section, the AI assistant adeptly navigated this task, yielding a proposal of commendable quality, approved by the funding entity.

This methodology showcases the potential of generative AI in streamlining the grant application process, highlighting the technology's adaptability to varying linguistic standards and its proficiency in enhancing the appeal of proposals to evaluators.

Segmentation of grant application process into steps

In this study, I systematically quantified the duration required for each stage involved in generating a grant proposal using ChatGPT assistant. These stages encompassed the initial configuration of the GPT assistant, the uploading of grant guidelines, the input of brief project descriptions, the creation of a grant structure, the production of pertinent text for each section, the formulation of team curricula vitae in alignment with specified guidelines, the compilation and justification of the budget, the evaluation of the grant application's adherence to guidelines, the generation of any missing components, and the final verification and simulation of the grant application assessment process. Additionally, I scrutinized specific challenges encountered during each phase and elucidated the strategies employed to resolve these issues, providing a comprehensive overview of the process and its intricacies.

Although the preparation of an application can be segmented in various ways, I have proposed a distinct division that maximizes the capabilities of generative AI. This structured breakdown not only leverages the full potential of AI but also delineates which segments of the process can be fully automated versus those that necessitate human intervention or supervision, thereby optimizing the integration of technology and human expertise in the application preparation process.

4. Results

As outlined in the Introduction, this study explores five key facets of generative AI's influence on the grant application process: productivity, quality, project team skills, automation of the application writing process, and policy implications. The findings detailed in this section, and summarized in Table 1, delve into the initial four dimensions. Discussion of policy implications, in contrast, is reserved for the discussion section, where we contextualize our findings within the broader framework of evolving grant application standards and practices.

Averall the time needed for preparing the full application, not counting the time needed for collecting the formal documents, such as the applicant’s audited financial report, varied from 14 to 20 hour of my work. The preparation process did not involve any other person. This time requirement also does not include the time spent by the project teams to prepare short project outline.

I generated four applications using ChatGPT, two were accepted and two were rejected by the grantors. From the Sloan Foundation I received a highly favorable evaluation with no requests for clarifications, amendments, or corrections. CPMA approved the proposal and the budget, with few minor clarification requests regarding the costs’ classification and justification. NED rejected both proposals stating that with limited resources available, only a small number of the many proposals they receive could be approved.

I had only limited experience in working with ChatGPT, mostly concentrated on using the ChatGPT for generating the Python code for my research needs. Also, I have not utilized any publications that outline different prompting strategies. Therefore it can be concluded that the presented results in terms of productivity and quality cannot be achieved by a novice ChatGPT user, but neither they require the skills of the professional prompt engineer.

The following stages of the grant application writing have been fully automated: generation of the grant structure (with the exception of the CPMA grant, when the structure was imposed by the application portal), generating text for each section, generating teams qualifications based on the provided CVs, generating budget justification, assessment of draft compliance with the guidelines, generating the missing components, final application verification and simulation of grant application assessment, and generating the introductory letter.

The following stages require human input: preparing a short project outline, preparing the budget in Excel format and collecting the formal documents specified in the grant guidelines. It should be noted that in one case I used the existing grant application and provided bullet points with necessary modifications, so the process was partly automated. While there are many applications available for ChatGPT that can create nicely formatted Excel tables, it is still very difficult to automatically generate the appropriate budget table. Although I envisage that with ongoing rapid technology advancement soon it will be possible to generate the budget proposal based on the provided template, list of items (such as names of function and major cost items), while the generative AI will search Internet for specific cost estimates.

I encountered the following problems when generating the specific sections of the grant proposal. The generations of team members CVs in line with the grant outline requirements and highlighting experience and skills relevant for the project required several iterations, mostly since the actual CVs provided by the project team members were in different format. Also, in the case of the grant application where I had a very limited domain knowledge I relied much more on the ability of the GPT assistant to search the Internet for best practices in the area of civic education and human rights advocacy. This required more iterations than in the case of projects where I had significant expert knowledge.

The detailed results of the grant application generation process are documented in Table 1.

Table 1.
Stages of the generation of four grant applications by the ChatGPT assistant, time needed and key observations.

Grant writing stage	Grant 1 - Sloan		Grant 2 - NED		Grant 3 - NED		Grant 4 - CPMA	
	Comment	**Time (hours)**	**Comment**	**Time (hours)**	**Comment**	**Time (hours)**	**Comment**	**Time (hours)**
Initial GPT Assistant Configuration	The inaugural utilization of the GPT for generating grant applications necessitated an extended initialization period compared to subsequent instances. The configuration parameters were consistent with those applied in the other three scenarios.	1	Standard Functionalities Enabled: Included capabilities such as interpreting Word and PDF documents, conducting internet searches for best practices, and adapting to the language specifications mandated by the funding organization.	0.25	Standard Functionalities Enabled: Included capabilities such as interpreting Word and PDF documents, conducting internet searches for best practices, and adapting to the language specifications mandated by the funding organization.	0.25	Standard Functionalities Enabled: Included capabilities such as interpreting Word and PDF documents, conducting internet searches for best practices, and adapting to the language specifications mandated by the funding organization.	0.25
Upload Grant Guidelines	Grant guidelines uploaded as a 13-page PDF document.	0.1	Grant guidelines uploaded as an 8-page Microsoft Word document.	0.1	Grant guidelines uploaded as an 8-page Microsoft Word document.	0.1	Grant guidelines uploaded as a 26-page Microsoft Word document.	0.1
Upload Short Project Description.	A two-page project description including a general timeline was submitted.	0.1	A comprehensive three-page project description was submitted, detailing the theoretical components and delegating the creation of the implementation component to the GPT system.	0.1	The grant application was augmented with individual one-page descriptions for each of the three distinct activities, along with a general overview of the research center's activities that applied for the grant.	0.1	The second grant application, produced by GPT, was adapted by expanding the research component and curtailing the implementation section. Additionally, geographical coverage adjustments were made, resulting in the second and fourth grant applications being synergistic.	0.25

Cont. table 1.

Generate Grant Structure	Utilized GPT to construct a structured grant application in a Microsoft Word format, adhering to provided guidelines.	0.1	Employed GPT to formulate a structured grant application in a Microsoft Word format, in accordance with the specified guidelines.	0.1	Engaged GPT to develop a structured grant application in a Microsoft Word format, consistent with established guidelines.	0.1	The grant application, submitted through a specialized portal, conformed to a mandatory structure specified by the portal.	NA
Generate the Appropriate Text for Each Section.	Multiple iterations were necessary to generate the appropriate text for certain sections.	4	Multiple iterations were necessary to generate the appropriate text for certain sections.	6	Repeated iterations were needed for particular sections, with the text generation process involving verification by the project leader due to limited domain knowledge, resulting in a longer development time compared to other applications.	8	Numerous iterations were needed to produce text that complied with the character limits imposed by the application portal for each section. The complexity of the application, due to it being submitted to an organization distributing European Union funds, was significantly higher than that for applications to United States grantors.	10
Generate Synthesized Team Qualifications to Meet Specified Guidelines	The curricula vitae (CVs) of project team members, initially received in varying formats including PDF and Word, exhibited diverse structures and content. These documents were individually uploaded to the GPT system, which was then instructed to regenerate the CVs to conform to the format mandated by the	1	The curricula vitae (CVs) of project team members, initially received in varying formats including PDF and Word, exhibited diverse structures and content. These documents were individually uploaded to the GPT system, which was then instructed to regenerate the CVs to conform to the format mandated by the	0.75	The curricula vitae (CVs) of project team members, initially received in varying formats including PDF and Word, exhibited diverse structures and content. These documents were individually uploaded to the GPT system, which was then instructed to regenerate the CVs to conform to the format mandated by the	0.75	The curricula vitae (CVs) of project team members, initially received in varying formats including PDF and Word, exhibited diverse structures and content. These documents were individually uploaded to the GPT system, which was then instructed to regenerate the CVs to conform to the format mandated by the	0.75

	grantor's guidelines. The focus was placed on highlighting those aspects of the CVs deemed vital for a successful grant application. This process necessitated multiple revisions.		grantor's guidelines. The focus was placed on highlighting those aspects of the CVs deemed vital for a successful grant application. This process necessitated multiple revisions.		grantor's guidelines. The focus was placed on highlighting those aspects of the CVs deemed vital for a successful grant application. This process necessitated multiple revisions.		grantor's guidelines. The focus was placed on highlighting those aspects of the CVs deemed vital for a successful grant application. This process necessitated multiple revisions.	
Budget Compilation and Justification	The budget was meticulously compiled in Excel format, with a human operator overseeing the process. Subsequently, justifications for each budget line item were synthesized using GPT to ensure alignment with the project's financial plan	4	The budget was meticulously compiled in Excel format, with a human operator overseeing the process. Subsequently, justifications for each budget line item were synthesized using GPT to ensure alignment with the project's financial plan	5	The budget was meticulously compiled in Excel format, with a human operator overseeing the process. Subsequently, justifications for each budget line item were synthesized using GPT to ensure alignment with the project's financial plan	6	The budget was meticulously compiled in Excel format, with a human operator overseeing the process. Subsequently, justifications for each budget line item were synthesized using GPT to ensure alignment with the project's financial plan	4
Assessment of Draft Compliance with Guidelines	The draft grant application was uploaded to the GPT system, which was then tasked with evaluating the document to ensure its adherence to the guidelines and overall completeness.	0.25	The draft grant application was uploaded to the GPT system, which was then tasked with evaluating the document to ensure its adherence to the guidelines and overall completeness.	0.25	The draft grant application was uploaded to the GPT system, which was then tasked with evaluating the document to ensure its adherence to the guidelines and overall completeness.	0.25	In light of the application's submission through the portal, an alternate version was maintained in a Microsoft Word document. This draft was uploaded to GPT, which was then directed to confirm its thoroughness and compliance with the required standards.	0.5

Cont. table 1.

Ask GPT to Generate the Missing Components	GPT identified and supplemented missing components of the application, providing enhancements for certain elements.	2	GPT identified and supplemented missing components of the application, providing enhancements for certain elements.	2	GPT identified and supplemented missing components of the application, providing enhancements for certain elements.	3	GPT made suggestions to improve some components.	1.5
Final Verification and Simulation of Grant Application Assessment	GPT conducted the final assessment of the grant application, offering minor enhancements. Furthermore, GPT evaluated the proposal's quality, predicting a favorable outcome.	1	GPT conducted the final assessment of the grant application, offering minor enhancements. Furthermore, GPT evaluated the proposal's quality, predicting a favorable outcome.	1	GPT conducted the final assessment of the grant application, offering minor enhancements. Furthermore, GPT evaluated the proposal's quality, predicting a favorable outcome.	1	GPT performed the final evaluation of the grant application, providing minor suggestions for improvement. Utilizing the assessment criteria from the guidelines, GPT rated the application, which resulted in a highly favorable evaluation.	1.25
Generate Introductory Letter		0.1		0.1		0.1		0.1
TOTAL hours		**13.65**		**15.65**		**19.65**		**18.7**
Additional Tasks Not Supported by Generative AI (yet)	Two additional documents pertaining to the legal and financial status of the applicant were necessitated.	NA	Two additional documents pertaining to the legal and financial status of the applicant were necessitated.	NA	Two additional documents pertaining to the legal and financial status of the applicant were necessitated.	NA	Eleven additional documents concerning the legal and financial status of the applicant were necessitated.	NA
Requested Grant Amount	50,000 USD	NA	198,000 USD	NA	148,440 USD	NA	99,488 EUR	NA
Grant Application Outcome	The application was approved, receiving a highly favorable evaluation with no requests for clarifications, amendments, or corrections.	NA	The application was rejected, evaluation not available.	NA	The application was rejected, evaluation not available.	NA	The application was approved, minor corrections were requested regarding the classification of expenditures, the total requested budget was approved.	NA

5. Discussion

On average it takes 116 Principal Investigator (PI) hours and 55 Co-Investigator (CI) hours to write a grant proposal for federally funded research in the field of astronomy and psychology (von Hippel and von Hippel, 2015) and 38 days in medical research (Herbert et al., 2013). The success rate is in the range of 10 to 25 percent depending on the field (Herbert et al., 2013; Santoro, 2021; von Hippel, von Hippel, 2015). For EU-funded research, such as Horizon 2020, application success rates are around 15 percent (Schembri-Wismayer et al., 2018). Schweiger (2023) surveyed Austrian applicants from research and industry and found that preparing a new proposal takes about 50 working days. Moreover, more than 90% of researchers perceive that they currently spend too much time preparing proposals and only 10% of researchers believe that the current competitive funding system has a positive effect on the quality of research.

In the case of grant applications discussed in this paper the time needed to prepare a research idea in the form of a 2-3 pager was in the range of 2-4 days, accompanied by one or two meetings or Zoom conference calls. The actual generation of the grant application took between 14 and 20 hours. It means that the time needed for preparing a grant application from the ideation to submission stage was massively reduced, from around 30-50 days to 3-5 days. At the same time the success rate was 50 percent, well above average research grant application success rates reported in the literature.

The applying institutions, the team members and the PI had no prior experience of applying to the targeted funding organizations. The Principal Inverstigator's Google Scholar h-index is 14 and the PI has published 11 papers in Q1-Q3 refereed journals in the previous five years. It means that the experience and the track record of the applicant cannot be considered as very advantageous, and that funding organizations' decisions were based on the quality of generated applications.

It should be noted that the author of this paper and the co-PI in all four submitted applications has only limited experience in using generative AI, and has no formal training in prompt engineering. It means that even such limited generative AI experience in adequate for the effective use of ChatGPT functionality to create high quality grant proposals in a very short time. It is clear that generative AI applications are set to become more than tools, they have the potential to become valuable "members" of the project team (Bianchini et al., 2022).

The remainder of this section discusses the implications for the grant application procedures and standards as well as wider research funding policy implications. It also presents the limitations of the proposed research methodology.

Evolution of grant application standards – dealing with commoditized requirements

Various sections of grant application can be easily generated within minutes with the help of LLM by a person that has very limited or no domain knowledge, i.e. can be "commoditized". Examples of such sections in the four grant applications analyzed in this paper are[1]: abstract or summary of the project (H), background of the project (M), literature review (M), project evaluation methods and plan (M), dissemination strategy and communication plan (M), budget justification (M), other sources of support and sustainability of future funding (L), diversity, equity and inclusion plan (H), curricula formatting (H), applicant organization background and strength (M), stakeholder engagement plan (M), risk assessment and mitigation strategy (H).

As these sections are easy to generate in high quality with the help of LLMs, the marginal utility of these sections in the overall evaluation of the grant proposal will likely fall over time. At the same time evaluators will have to commit significant time and effort to read and assess these sections' contribution to the overall quality of the grant proposal. Many researchers complain that evaluating long grant proposals eats into their valuable time that can be devoted to genuine research or teaching. This situation calls for a review of application standards adopted by funding organizations to orient the grant evaluation process on application sections that cannot be commoditized and reduce or fully eliminate the evaluation of parts that can be written by generative AI. Ideally the grant application should be split into parts, first that requires a human expert contribution and is related to the merits of the project, and second that incudes commoditized parts. The first part would be evaluated by field experts, and the second part will be subject to formal evaluation by funding organization officers.

Guidelines for using generative AI for grant applications

In order to streamline the formal evaluation of the second part, the funding organization could recommend the LLM that should be used to generate sections in this part of the application and even release the set of recommend prompts that should be used for generation of the second – commoditized - part of the application. This information could be a part of funding organization guidelines on the use of generative AI for preparing grant applications.

It should be noted that outright ban on the use of ChatGPT for grant application generation will be highly ineffective and is not recommended. However, while encouraging the use of generative AI for writing the second part of the grant application, the funding organization could explicitly ban the use of generative AI in preparing of the first part of the grant application, that describes the research idea, methodology, data used and expected products, outputs and outcomes of the proposed project. Tools such as ChatGPT could be used in this part only for correcting the language, which will be especially useful for English language non-native speakers. The grant application should be accompanied by a project team statement that the use

[1] H denotes highly commoditized area, M – medium commoditized area, L – area with some potential for commoditization.

of generative AI in writing the first part of the application was limited to language correction only. However, the use of generative AI should be allowed or even encouraged when submitting interim or final reports related to received funding. Overall, the proposed principles would contribute to ensuring the integrity and originality of grant proposals and address ethical concerns related to generative AI in the grant writing process.

Creating a level playing field for junior faculty

The grant success rate for junior faculty can be as low as 10 per cent (Freel et al., 2017) indicating that the path to financial independence is very long for early stage researchers. While mentorship initiatives (Bagaka's et al., 2015; Jackevicius et al., 2014; Spence et al., 2018) and dedicated funding programs for young faculty (Wang et al., 2018) address this problem to some extent, the above proposal to encourage the use of generative AI to write commoditized parts of grant applications would contribute to creating a level playing field for young scientist. They would spend less time and effort trying to write long grant proposals fulfilling all, often complicated and not directly related to their research field, formal requirements and could devote more time to work on their research ideas. It will create fair and equal opportunities for everyone involved, especially for researchers who are just starting out or might not have as much grant-writing experience or resources as others.

Implications of generative AI use for equity and access in grant funding opportunities.

Because generative AI has no ethnicity, nationality or gender, these proposals should help in reducing the bias towards women and minorities in research funding and recognition, often reported in the literature (Lauer, Roychowdhury, 2021; Lerchenmueller, Sorenson, 2018; Zhou et al., 2024). Moreover, standardizing and commoditizing of these sections of the grant application would ensure, that the submitted applications do take into account requirements related to the diversity of project team members and project beneficiaries.

Grant application information sharing requirements

It is recommended that with an appropriate time delay the funding organizations publish anonymized texts of grant applications, both those that received and did not receive funding. It would serve several purposes. Firstly, it would facilitate a greater transparency of the funding decision process. Secondly, scientists could learn from their own and their peers' past mistakes. Thirdly, LLMs could be fine-tuned using the grant applications data to provide better assistance for scientists when generating the second, commoditized, part of their future applications. Fourthly, such information-sharing standard would allow funding organization to learn from the experience of other funding organizations. Finally, availability of such data would encourage research on the efficiency of various funding schemes. This proposal also contributes to the ongoing discussion on the need to mandate sharing of user information in data-driven markets (Graef, Prüfer, 2021).

Insights into future workforce skill requirements and training needs for effective AI collaboration in grant writing

The research underscores the rapid evolution of AI technologies and their application in grant writing, suggesting that adaptability and a commitment to continuous learning are essential for future grant writers (Meyer et al., 2023; Jain, Jain, 2023). Professionals will need to stay abreast of the latest AI advancements and understand how to apply these tools effectively within the grant writing process. The findings also indicate that AI can significantly reduce the time required for grant writing while potentially improving the quality of proposals (Glickman, Zhang, 2024; Lin, 2023). Future training should emphasize the strategic use of AI to enhance creativity and efficiency, teaching individuals how to leverage AI for brainstorming, drafting, and revising grant proposals. This includes understanding the strengths and limitations of AI and integrating human creativity with AI capabilities to produce innovative and compelling grant applications.

Reflecting on concerns highlighted in the literature, future workforce development must address ethical considerations and transparency in AI usage (Fui-Hoon Nah et al., 2023; Korinek, 2023). Training needs to cover the ethical implications of using AI, including issues around data privacy, intellectual property, and the potential for bias. Furthermore, individuals should be trained on the importance of transparently disclosing AI assistance in grant proposals to uphold integrity and trust in the scientific community.

Finally, the research suggests the importance of interdisciplinary collaboration in developing and applying AI tools for grant writing (Garrido-Merchan, 2023; Gozalo-Brizuela, Garrido-Merchán, 2023). Future training programs should, therefore, include developing skills for effective collaboration across disciplines, enabling grant writers to work alongside AI developers and subject matter experts, which extends the recommendations provided in Arnold et al. (2021). This collaborative approach ensures that AI tools are tailored to specific research contexts and that grant proposals are grounded in deep disciplinary knowledge.

Research limitations

This research has several limitations. Despite efforts to include a diverse set of projects into the analysis (research-oriented projects and civic society development projects with research component, projects with and without use of innovative technology, using human-generated short project outlines and previously generated proposal and the input, US-based and EU-based grantors, state and private sector grantors, different geographies and scale) the sample consists of only four grant proposals. So it may be argued that the results (two applications approved, two applications rejected) depend on luck as much as on the quality of the generated proposals. Nonetheless, as it this the first such research in the literature, I consider that it still offers important insights into the role of the generative AI in grant application writing.

The second limitation, which is typical for all applications of the LLMs is related to a lack of the reproducibility of the research results. If I attempted to generate grant applications again, even using the same prompts, the generated text will be different. It is due to the very nature of the LLMs but also is related to the fact that new versions of these models are released often and even if one uses that same model, their creators continuously modify the rules of their use to ensure better functionality and quality, stronger adherence to the ethical standards and reduction of various biases. To some extent this problem can be mitigated by downloading pre-trained LLMs that are available as open source, for example from the huggingface.co platform. But it leads to another problem. To run such models one often needs an access to powerful GPUs, which are very expensive and are not available in most personal computer used by researchers. Instead, one can use paid cloud services provided by Microsoft, Google or AWS, but it requires that the project team includes a data engineer capable of setting up such compute environment. But it seems that this very hot area of applied research utilizing LLMs will have to struggle with the research non-reproducibility for a foreseeable time. In this respect LLMs closely mimic the human behavior. A human researcher would not be able to replicate his grant proposal word-for-word, if asked to do it after some time elapsed.

A further limitation of AI-generated proposals is the challenge of ensuring accurate and in-depth domain-specific content. While generative AI models can synthesize coherent and well-structured text, they may lack the nuanced subject-matter expertise necessary to convey advanced technical details or discipline-specific knowledge accurately. This shortfall often becomes evident in specialized grant applications requiring familiarity with cutting-edge research, intricate methodological frameworks, or context-specific legal and ethical considerations. AI systems can occasionally produce “hallucinations” or factual inaccuracies that appear plausible but are actually incorrect, underscoring the importance of expert review. Consequently, even when proposals are generated rapidly, they still require thorough validation by individuals who possess the relevant academic or professional background. Without such oversight, the risk of errors in AI-generated content - especially in highly specialized fields - can undermine the credibility and competitiveness of the proposal.

6. Conclusions and directions for further research

In the evolving landscape of grant writing, particularly within the realms of federally funded research and EU projects like Horizon 2020, the investment of time and resources is substantial. Fully human-prepared grant application takes 30-50 days to complete, with success rates lingering around the 10-20% mark. This considerable effort, juxtaposed against the modest odds of securing funding, underscores a demanding and competitive environment.

Recent insights, however, reveal a paradigm shift facilitated by the integration of generative AI, specifically tools like ChatGPT, into the grant writing process. An innovative approach highlighted in this research showcases the potential to drastically reduce the time required for preparing grant applications to a mere 3-5 days. This reduction in preparation time does not come at the expense of application quality or success rates, suggesting a significant efficiency gain. The applications in question, submitted without prior experience with the targeted funding bodies and by teams led by a Principal Investigator with moderate academic track records, suggest that the quality of the application, rather than the reputation of the applicants, becomes the focal point in funding decisions. Among four submitted grant proposal two were accepted and two were rejected, with a success rate of 50 percent.

This shift is further underscored by the admission that the success in utilizing generative AI for grant proposal generation was achieved with limited experience in AI and without formal training in prompt engineering. It suggests that even a basic proficiency in generative AI tools can enable researchers to produce high-quality proposals efficiently. This democratization of the grant writing process may level the playing field, particularly for junior faculty and researchers from less represented demographics, potentially mitigating longstanding biases in funding allocations.

The implications of these findings extend beyond mere operational efficiencies. They invite a re-evaluation of grant application standards and the criteria for assessment by funding bodies. With generative AI capable of commoditizing sections of grant applications, there's a call for these organizations to differentiate between contributions that require human expertise and those amenable to automation. This bifurcation not only streamlines the evaluation process but also redirects the focus towards the innovative and substantive merits of proposed research projects.

Moreover, the strategic use of generative AI in grant writing posits a dual challenge and opportunity: maintaining the integrity and originality of research proposals while embracing the efficiencies AI offers. Recommendations for funding bodies to guide the ethical use of AI in grant writing, including transparent disclosures of AI assistance, reflect a balanced approach to integrating these technologies. This guidance ensures that while AI can assist in drafting and refining proposals, the core ideas and methodologies remain the product of human intellect and creativity.

The evolution of AI in grant writing also signals a shift in skill requirements for future researchers and grant writers. A commitment to continuous learning, adaptability, and an understanding of the ethical implications of AI use become paramount. Training programs will need to address these competencies, ensuring that professionals can effectively leverage AI tools in a manner that enhances, rather than undermines, the research funding landscape.

The integration of generative AI into the grant writing process represents a significant leap forward in efficiency and accessibility. By reducing the time and effort required to prepare competitive proposals, AI has the potential to democratize research funding, making it more accessible to a broader range of investigators. However, this technological advancement also necessitates a re-evaluation of application standards, ethical considerations, and the skills required for effective collaboration between humans and AI. As we move forward, the challenge will be to harness the potential of AI in a way that preserves the integrity of the scientific inquiry while opening up new avenues for innovation and discovery.

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